SELF- VERSUS INFORMANT REPORTS OF POSTTRAUMATIC STRESS DISORDER: AN APPLICATION OF ITEM RESPONSE THEORY

A Thesis

by

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ABSTRACT

As men and women return from serving on the frontlines of Operations Enduring Freedom (OEF; Afghanistan) and Iraqi Freedom (OIF; Iraq), many struggle with emotional or behavioral difficulties stemming from the stresses of battle. However, research has shown that these service members may be unwilling or unable to recognize or report such difficulties due to such factors as amnesia, avoidance, or cognitive impairment. Hence, the burden to recognize distress and encourage treatment increasingly falls on peers, friends, and especially intimate partners. Given that this responsibility is often placed on significant others, it is imperative to determine which symptoms are amenable to detection by informants and which are not. The current study examined the ability of female spouses of Vietnam veterans to report on various indicators of posttraumatic stress disorder (PTSD) using the Mississippi Scale for Combat-Related PTSD. Item response theory (IRT) analyses were conducted with a dataset composed of both self- and informant reports using the same items regarding the same individual in order to examine the item-level properties.

Results from these analyses indicated that the ability of both spouses and veterans to detect PTSD symptoms varies across item content and that items themselves do not relate equally to, or become diagnostic at the same level of, PTSD. Overall, veterans showed greater sensitivity to their own symptoms and were able to provide more information than their spouses for nearly every item rated by independent experts to be overt or covert. However, some items provided greater information when endorsed

by the spouse versus the veteran even though, consistent with the majority of other items, these items were endorsed by the spouse only once the PTSD symptoms had reached greater severity. Implications of these findings as well as future directions for research regarding observer reports of PTSD symptomatology were explored.

NOMENCLATURE

2PL	Two Parameter Logistic
APA	American Psychiatric Association
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CTT	Classical Test Theory
DSM	*Diagnostic and Statistical Manual of Mental Disorders*
ICC	Item Characteristic Curve
IIC	Item Information Curve
IRT	Item Response Theory
NSVG	National Survey of the Vietnam Generation
NVVRS	National Vietnam Veterans Readjustment Survey
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
PCL-M	PTSD Checklist – Military Version
PTSD	Posttraumatic Stress Disorder
RMSEA	Root Mean Square Error of Approximation
SMSA	Standard Metropolitan Statistical Areas
TIC	Test Information Curve
TLI	Tucker-Lewis Index

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

As men and women return from serving on the frontlines of Operations Enduring Freedom (OEF; Afghanistan) and Iraqi Freedom (OIF; Iraq), it is not uncommon for friends, family members, fellow service members, and unit leadership to sense that they have "changed." However, these service members may be unwilling or unable to acknowledge to themselves or others that they are struggling with emotional or behavioral difficulties resulting from the stresses of battle. Failure to recognize or report such difficulties may arise from numerous factors including amnesia, avoidance, or cognitive impairment (Wilson & Keane, 2004), and may be perpetuated through the administration of questionnaires that rely on transparent items to assess for mental health problems such as posttraumatic stress disorder (PTSD) upon service members' return. Unfortunately, minimizing one's PTSD symptomatology not only results in a lack of treatment, but can also have implications for combat readiness, mission assignment, rank promotion, job placement, and interpersonal functioning (Hoge et al., 2004). Given service members' capacity to underreport symptoms and avoid treatment, the burden to recognize distress and encourage treatment increasingly falls on peers, friends, and especially intimate partners. Therefore, it may be useful or even imperative that these individuals be included whenever possible in the assessment of PTSD, and to have reliable and valid measures for doing so.

PTSD is an episodic syndrome consisting of multiple domains that develops in response to stressor events that are outside the realm of normal experience. It is characterized by three symptom clusters that represent reexperiencing, avoidance/numbing, and hyperarousal symptoms. Reexperiencing symptoms include intrusive memories, nightmares, flashbacks, and physiological and psychological reactivity in response to triggers. Avoidance/numbing symptoms consist of the avoidance of thoughts and behaviors associated with the traumatic event, the inability to recall details of the experience, diminished interest, emotional detachment, dampened affect, and the belief that one's life will be cut short. Hyperarousal symptoms are comprised of sleep disturbance, irritability and anger, difficulty concentrating, hypervigilance, and exaggerated startle response. A diagnosis of PTSD based on the criteria in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR; American Psychiatric Association, 2000) requires the endorsement of at least one reexperiencing symptom (out of five), three avoidance/numbing symptoms (out of seven), and two hyperarousal symptoms (out of five) or the use of a specific cutoff score on some standardized measure. Given the heterogeneous nature of the disorder, it is possible for two persons to experience the debilitating effects of PTSD, but to have very different diagnostic pictures. Furthermore, those who do not meet full criteria can still experience distress from the symptoms associated with partial PTSD. Regardless of the service member's specific symptom structure, PTSD not only has the potential to affect all aspects of the service member's life, but also the lives of those closest to him or her.

Although a variety of individuals may be impacted by a service member's PTSD symptomatology, intimate partners form adults' primary sources of support (Beach, Martin, Blum, & Roman, 1993); therefore, it is often the service member's partner or spouse who is most negatively affected by the service member's distress. Indeed, numerous studies have shown strong links between PTSD and intimate relationship problems (see Galovski & Lyons, 2004, for a review). However, just as PTSD does not manifest itself identically in each individual (as evidenced by the need for a cluster scoring method), so too does the disorder differentially influence intimate partners.

A growing body of research has begun to examine the differential impact of symptom clusters on couple functioning. Although reexperiencing symptoms may be intrapersonally upsetting due to the recall of traumatic events, such symptoms are not typically as disturbing to others because they represent a primarily internal experience (Evans, Cowlishaw, Forbes, Parslow, & Lewis, 2010). Conversely, hyperarousal and avoidance symptoms can have behavioral and affective expressions that may be distressing to intimate partners (Solomon, Dekel, & Zerach, 2008). Specifically, hyperarousal can lead to heightened physiological reactivity, anger, and irritability, whereas avoidance can result in detachment from others and diminished interest in previously enjoyed activities (Taylor, Kuch, Koch, Crockett, & Passey, 1998).

Given that an intimate partner is differentially affected by the various symptom clusters of PTSD, one could anticipate that the accuracy of partner reports would vary based on the degree to which symptoms are overt (e.g., behaviors and actions) or covert (e.g., thoughts and feelings). Indeed, the partner has only two sources upon which to

base an estimate of a service member's PTSD symptoms: the service member's verbal reports and the partner's observations of the service member's behavior (Gallagher, Riggs, Byrne, & Weathers, 1998).

Despite the fact that an intimate partner may not be able to report accurately on all aspects of a service member's PTSD symptomatology, the partner's collateral report has the potential to confirm or clarify a service member's self-report and provide further information about prior functioning as well as the home environment. Such a multimethod, multisource approach to assessment was initially implemented with the classical test theory (CTT) notion that all measures of a disorder are imperfectly related to the underlying condition and that multiple measures from different domains or respondents may improve diagnostic accuracy and confidence (Wilson & Keane, 2004). However, CTT is not fully capable of demonstrating that the ability of intimate partners or other observers to detect various indicators of PTSD may vary across item content (e.g., covert versus overt indicators), and that items themselves may not relate equally to PTSD or become diagnostic at the same level of PTSD. In order to evaluate such hypotheses, it is necessary to examine the item-level properties of both self- and informant reports. This can be accomplished by conducting item response theory (IRT) analyses with a dataset composed of both self- and informant reports using the same items regarding the same individual.

In order to use IRT, unidimensionality and local independence of the underlying trait (i.e., PTSD) must first be established. Once these two key assumptions are met, item parameters can be estimated. With two parameter logistic (2PL) IRT analyses, there are

two parameters: a discrimination or slope parameter (*a*) and a difficulty or threshold parameter (*b*). The *a* parameter describes how closely the item relates to the latent underlying trait (θ). The *b* parameter indicates the point on the latent trait at which the probability of endorsing the item is equal to 0.50. Using the *a* and *b* parameters for each item, a series of S-shaped item characteristic curves (ICCs) can be plotted with the latent trait (θ) represented on the x-axis and the probability of endorsing the item represented on the y-axis (Embretson & Reise, 2000). These parameters can further be used to produce roughly bell-shaped item information curves (IICs) with the latent trait (θ) plotted on the x-axis and the amount of item information plotted on the y-axis. In this case, information refers to the precision of measurement at varying levels of the underlying construct, with higher information denoting greater precision (Reeve, 2002). The data gleaned from these plots can then be used to adapt existing assessments or develop new ones that better capture the target construct. As applied to the current study, IRT can be used to evaluate the differential relatedness of individual items on a standardized measure of PTSD to the intended latent construct of posttraumatic stress, and to compare the functioning of these items across service members and observers in their social environment.

Emerging evidence affirms that service members returning from lengthy deployments to Iraq and Afghanistan demonstrate high risk not only for experiencing acute symptoms of PTSD, but also for exhibiting enduring changes in habits, lifestyle, communication, interpersonal relations, and wellness behaviors (Conoscenti, Vine, Papa, & Litz, 2009). Often, those around them are aware of such changes, but feel powerless to

help. By examining current approaches to PTSD assessment and determining those items that are most useful for identifying and describing PTSD symptomatology in this population, researchers can not only improve the diagnostic efficiency of both self- and informant reports, but also empower those in the service member's life to seek help on his or her behalf.

2. METHOD

2.1 Description of Data

Data for the current study come from the National Vietnam Veterans Readjustment Survey (NVVRS), a study mandated by the United States Congress in 1983 as part of Public Law 98-160. Broadly, its purpose was to determine "the prevalence and incidence of post-traumatic stress disorder (PTSD) and other psychological problems in readjusting to civilian life" among Vietnam veterans. Additional goals included providing detailed information about PTSD and describing the total life adjustment of Vietnam theater veterans compared to the adjustment of era veterans and nonveterans (Kulka et al., 1990b).

The NVVRS consisted of three component studies: (1) the National Survey of the Vietnam Generation (NSVG), a survey interview intended to meet the study's major informational objectives, (2) the Clinical Interview, a semi-structured diagnostic interview designed to improve the accuracy of the study's estimates of PTSD prevalence, and (3) the Family Interview, a face-to-face survey interview conducted with the spouses or co-resident partners of theater veterans.

2.2 Participants

2.2.1 Veteran sample

The NSVG was a three to five hour face-to-face interview conducted by trained lay interviewers in the homes of Vietnam theater veterans (i.e., those who served in Vietnam or its surrounding water or airspace during the period of August 5, 1964 to May

7, 1975), Vietnam era veterans (i.e., those who served in the military during the Vietnam War, but were not stationed in Vietnam or its surrounding areas), and their civilian counterparts. In order to obtain an initial estimate of PTSD symptomatology for this population, researchers administered the Mississippi Scale for Combat-Related PTSD (the Mississippi Scale; Keane, Caddell, & Taylor, 1988), a PTSD module similar to the Diagnostic Interview Schedule, and a thorough assessment of exposure to traumatic events. Candidates for the interview were randomly selected from the military records of all personnel who served during the Vietnam era. Written consent was obtained and interviews were conducted with 1,623 Vietnam theater veterans (83% response rate), 716 Vietnam era veterans (approximately 77% response rate), and 668 civilians (approximately 69% response rate) for a total of 3,016 interviews representing 78% of the cases determined to be eligible for interview. Analyses using military records data were conducted in order to determine differences between respondents and nonrespondents. Although no significant differences were found, all subsequent analyses used adjusted sampling weights to compensate for nonresponse and differing selection probabilities (Jordan et al., 1992).

2.2.2 Clinical subsample

The Clinical Interview was a semi-structured diagnostic interview conducted by expert mental health professionals with a subsample of theater veterans living in 28 Standard Metropolitan Statistical Areas (SMSAs). A key purpose of this interview was to distinguish PTSD cases from noncases through the use of the following assessments: the Structured Clinical Interview for *DSM-III-R*, Non-Patient Version (Spitzer,

Williams, & Gibbon, 1987); the Minnesota Multiphasic Personality Inventory PTSD scale (Keane, Malloy, & Fairbank, 1984); the Impact of Event Scale (Horowitz, Wilner, & Alvarez, 1979); the Stress Response Rating Scale (Weiss, Horowitz, & Wilner, 1984); and the Global Assessment Scale (Endicott, Spitzer, Fleiss, & Cohen, 1976). Of the Vietnam theater veterans who completed the NSVG, 42% were eligible for the Clinical Interview per the geographical restrictions imposed by the SMSAs. A total of 403 Vietnam theater veterans completed the interview, representing an 85% response rate.

2.2.3 Spouse/co-resident partner sample

The Family Interview component was a one-hour face-to-face interview conducted by trained lay interviewers with the spouses or co-resident partners of a subsample of theater veterans living throughout the U.S. For the sake of simplicity, these spouses/co-resident partners will henceforth be referred to as "spouses," although the couples may or may not have been legally married at the time of the interview. According to Public Law 98-160, the purpose of the Family Interview was to provide "an evaluation of the long-term effects of postwar psychological problems among Vietnam veterans on the families of such veterans (and on persons in other primary social relationships with such veterans)." Similar to the Clinical Interview, the goal of the Family Interview was to select all spouses of those theater veterans who were PTSD positive and a small subsample of spouses of those who were PTSD negative, but at high risk for developing the disorder due to their endorsed rates of combat exposure. Using data from the NSVG, it was determined that 585 theater veterans had eligible spouses and, of these, 466 were interviewed (an 80% response rate). Of the 466 interviewed, 376

were female spouses of male theater veterans and 90 were male spouses of female theater veterans.

2.2.4 Current study sample

For the current study, only data from male Vietnam theater veterans and their corresponding female spouses were analyzed. The decision to restrict the analyses to these dyads was due to the fact that, during the Vietnam era, men's modal roles in Vietnam were different from women service members' modal roles and typically involved significantly higher combat exposure. Therefore, restricting analyses to this subsample served to sharpen the focus of the study such that each group (i.e., Vietnam theater veterans and their spouses) could be expected to have more similar experiences and demographic characteristics. In other words, male Vietnam veterans' self-reported PTSD symptomatology was directly compared to the female spouses' reports of the veterans' PTSD symptomatology. Though it may be interesting to examine the differences between the spouse reports of male theater veterans and spouse reports of female theater veterans, the small sample of female veterans with participating spouses prohibited such analyses. Thus, the total pool of spouse respondents was reduced from the original 466 to 376 (eliminating the 90 male spouses) in order to analyze data from female spouses alone (Appendix A, Kulka et al., 1990a).

2.3 Measure

The Mississippi Scale for Combat-Related PTSD (the Mississippi Scale; Keane et al., 1988), the primary assessment for determining PTSD incidence in the NVVRS, has 35-item and 39-item versions that use 5-point, Likert scale response categories with

varying anchors (e.g., “Not at all True”/”Extremely True,” “Very Unlikely”/”Extremely Likely,” “Never True”/”Always True”). In the 39-item version – the focus of the current study – 29 of the items are scored such that high values indicate more extreme levels of the symptom and low values suggest little or no symptomatology. The other 10 items must be reverse-scored as high values indicate less PTSD symptomatology and low values indicate more. Traditionally, the Mississippi Scale has been used as a continuous measure of PTSD symptomatology by summing the respondent’s responses across items to arrive at a total score ranging from 35 to 175 for the 35-item version and from 39 to 195 for the 39-item version (Keane et al., 1988; Keane, Wolfe, & Taylor, 1987).

During the development of the Mississippi Scale, potential items were generated by five clinical psychologists who had extensive experience working with PTSD patients. Using a rational approach to scale refinement (Jackson, 1971; Nunnally, 1978), the research team narrowed the original 200-item pool to the 35 items deemed to be the best indicators of full PTSD symptomatology. These items not only assess for the symptoms outlined in the third edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-III; American Psychiatric Association [APA], 1980), but also examine additional features commonly associated with the disorder such as substance abuse, suicidality, and depression. The four items later added to create the 39-item version were selected to tap additional criteria set forth in the revised version of the DSM-III (DSM-III-R; APA, 1987; Lauterbach, Vrana, King, & King, 1997). These items assess symptoms of reexperiencing, amnesia, hypervigilance, and hyperarousal related to reminders of the traumatic event.

Previous research on the Mississippi Scale has been conducted primarily on the 35-item version due to the fact that the additional four items have not been found to increase the discriminative validity of the measure and are commonly omitted (Orsillo, 2001). Studies examining the reliability of the 35-item Mississippi Scale have shown high internal consistency (coefficient alpha – α) ranging from .94 for a sample of veterans involved in or seeking treatment to .95 for a community-based sample (Keane et al., 1988; Kulka et al., 1990a, 1990b). Keane and colleagues (1988) determined the test-retest coefficient (*r*) of the scale to be .97 (1-week interval between test administrations) with a mixed sample of nontreatment-seeking veterans, psychiatric outpatient veterans, and psychiatric inpatient veterans. Based upon these data, the Mississippi Scale appears to be internally consistent across independent samples of veterans as well as temporally stable across testing occasions.

In addition to testing the reliability of the scale, Keane and colleagues (1988) also examined the 35-item Mississippi Scale's validity using two separate samples of Vietnam veterans. First, it was determined that there was a significant correlation ($r = .25$, $p < .001$) between scores on the Mississippi Scale and scores on a measure of combat exposure, supporting the notion that increased exposure to trauma results in elevated stress reactions. Next, scores for veterans with a pre-existing PTSD diagnosis, veterans with other psychiatric diagnoses, and veterans with no pre-existing mental health concern were compared. The mean scores on the Mississippi Scale for these veterans were 130, 88, and 74 respectively with the veterans having PTSD scoring significantly ($p < .001$) higher than veterans with other psychiatric diagnoses who, in

turn, scored marginally higher ($p < .10$) than veterans with no mental health concerns. These findings further support the Mississippi Scale as a valid assessment due to its ability to distinguish those with PTSD from those without the disorder.

To date, two studies have examined the correlation between male veterans' scores on the Mississippi Scale and spouses' scores on a parallel version of the instrument (Niles, Herman, Segura-Schultz, Joaquim, & Litz, 1993; Taft, King, King, Leskin, & Riggs, 1999). Niles and colleagues (1993) administered the original Mississippi Scale to 59 treatment-seeking male combat veterans and a parallel version to the veterans' intimate partners in which the partners were asked to provide ratings of the veterans' PTSD symptomatology. After obtaining both the self-report and partner ratings, correlations for six rationally derived subscale scores (reexperiencing, numbing, avoidance, hyperarousal, guilt, and suicidality) as well as the total Mississippi Scale score were calculated. Veteran-partner correlations ranged from -.02 for the guilt subscale to .66 for the hyperarousal subscale. The correlation between total Mississippi Scale scores across partners was .54. In a separate study, Taft and colleagues (1999) analyzed data from the 466 veteran-partner dyads of the NVVRS and obtained the following correlations (r) between veterans' and their partners' scores: .61 for the total score, .61 for reexperiencing and avoidance, .51 for withdrawal and numbing, .53 for hyperarousal, and .33 for guilt and suicidality (all significant at $p < .001$). Both studies indicated moderate agreement between veterans and their partners regarding overall PTSD symptomatology. Furthermore, the variations in subscale correlations provide

additional support for the idea that partners' ability to report on PTSD symptoms varies as a function of whether the symptom is overt or covert.

2.4 Data Analyses

The current study examined the item-level properties of both informant and self-report versions of the 39-item Mississippi Scale using item-response theory (IRT). However, prior to conducting IRT analyses on the NVVRS Mississippi Scale data, it was first necessary to evaluate whether two key assumptions had been met. The most commonly used IRT models require that unidimensionality and local independence of the items be established prior to the application of IRT strategies. In other words, the items should assess for PTSD without measuring other underlying variables, and the probability of endorsing one item should be unrelated to the probability of endorsing any other item. With the case of unidimensional IRT (versus multidimensional IRT), local independence can be assumed once unidimensionality has been confirmed (Hambleton, Swaminathan & Rogers, 1991).

For this study, unidimensionality was established through the use of a confirmatory factor analysis (CFA) to test a one-factor structure. Analyses were conducted using Multilog (Thissen, Chen, & Bock, 2003) and three resulting goodness-of-fit indices were evaluated to determine the fit of the data to the proposed structure. The indices were as follows: the Tucker-Lewis index (TLI; Tucker & Lewis, 1973), the comparative fit index (CFI; Bentler, 1990), and the root mean square error of approximation (RMSEA; Steiger, 1990). Generally, good fit or unidimensionality is

obtained if the TLI and the CFI are each close to.95 and the RMSEA is less than .06 (Hu & Butler, 1999).

Although other IRT models were considered for analyzing the data, it was determined that, given the sample size for this study (n = 376 for both veterans and their spouses), more robust results would emerge from dichotomizing responses on the Mississippi Scale and running 2PL analyses. Extant literature indicates that increasing the number of response categories beyond two increases the need for larger samples as more parameters must be estimated (Reeve & Fayers, 2005). Therefore, decreasing the number of response categories permits the use of smaller samples as fewer parameters would need to be estimated. One means of decreasing the number of response categories for Likert scale items is through the dichotomization of each item at a predetermined cutoff. Although the Mississippi Scale was designed as a continuous measure of PTSD symptomatology and does not have suggested cutoffs for individual items, a similar scale that assesses for combat-related PTSD symptomatology through the use of 5-point, Likert scale items does.

Specifically, the PTSD Checklist – Military Version (PCL-M; Weathers et al., 1993) is a 17-item self-report inventory developed to assess the 17 symptoms of PTSD indicated in the fourth edition of the DSM (DSM-IV; APA, 1994). Respondents are asked to consider stressful military experiences and then rate these experiences on a Likert scale ranging from 1 (not at all) to 5 (extremely) to indicate how bothered they have been by a particular symptom during the preceding month. A diagnosis of PTSD can be based on an endorsement of at least one reexperiencing symptom (out of five),

three avoidance symptoms (out of seven), and two hyperarousal symptoms (out of five) or through the use of a specific cutoff score. Weathers and colleagues (1993) suggested a cutoff score of 3 for each item such that a score of 1 or 2 on an item would be considered a non-endorsement of that symptom and a score of 3 or above would be considered an endorsement.

Not only do the Mississippi Scale and the PCL-M share common features in both their item content (i.e., sets of items that assess the three PTSD symptom clusters indicated in the DSM) and response format (i.e., 5-point Likert scales), previous research has shown that the two instruments are highly correlated (r = .93) (Weathers et al., 1993). Hence, in dichotomizing items of the Mississippi Scale for the current study, a cutoff of 3 was used similar to previous research and recommendations for the PCL-M.

Once the items had been dichotomized such that item-responses below the cutoff of 3were considered a non-endorsement of the symptom and responses at or above 3 were an endorsement, CFAs were conducted first on the full 39-item scale and, subsequently, on subsets of the dichotomized items to confirm their unidimensionality and local independence in preparation for IRT analyses. Indeed, it was determined that sufficient unidimensionality was not obtained for both veterans and their spouses when a CFA was conducted on the full 39-item scale. Hence, it became necessary to determine which items were preventing unidimensionality from being achieved through the use of a series of CFAs. The results of these CFAs are displayed in Table 1. A 36-item scale eliminated the three suicide items; a 35-item scale eliminated the three suicide items and the substance abuse item; and a 34-item scale eliminated the three suicide items, the

substance abuse item, and item 39. It was determined that items 8 (“When I think of some of the things I have done in the past, I wish I were dead.”), 10 (“Lately, I have felt like killing myself.”), 15 (“I feel like I cannot go on.”), 29 (“There have been times when I have used alcohol (or other drugs) to help me sleep or make me forget about things that happened in the past.”), and 39 (“If something happens that reminds me of the past, I get so anxious or panicky that my heart pounds hard; I have trouble getting my breath; I sweat, tremble, or shake; or feel dizzy, tingly, or faint.”) were preventing unidimensionality from being achieved. It was concluded that these items were impeding unidimensionality due to the fact that the content of four of the items addresses criteria not required for a diagnosis PTSD (e.g., substance abuse and suicidality) and item 39 taps multiple facets of PTSD in a single statement. Hence, these five items were eliminated from subsequent analyses, resulting in a unidimensional 34-item version of the Mississippi Scale.

After the assumptions for IRT had been met, 2PL IRT analyses were conducted in order to obtain a single-ICC per item as well as a single-IIC per item. These ICCs and IICs could then be examined to determine the difficulty and discrimination of that item in the male Vietnam theater veteran sample compared to the spouse sample. However, an additional step, described below, was undertaken to facilitate subsequent interpretation and comparisons of the resulting curves.

It had previously been hypothesized that the theater veterans’ self-report IICs would look similar regardless of whether the symptom reflected by that item involved overt expression or covert experience. Conversely, the IICs for the female spouses were

hypothesized to vary as a function of whether the theater veteran's symptom was overt or covert. That is, it was hypothesized that a covert symptom would have to be more severe or intense before a female spouse was likely to detect it and endorse the corresponding item; an overt symptom may be more obvious and, therefore, the spouse would be able to observe and endorse it at a lower level of severity. Given these hypotheses, it was necessary to obtain data regarding the overt versus covert nature of each item from expert clinicians having experience working with PTSD in military populations prior to interpreting the results of the IRT analyses.

Thirty-five clinicians were asked to rate each of the 39 items of the NVVRS Mississippi Scale as being primarily overt, covert, or mixed in nature. The demographic characteristics of these clinicians as well as the overall results of their ratings are presented in Tables 2 and 3, respectively. Overall, the four items that were rated as overt with the greatest consensus (62% to 77% agreement) and generated the four most peaked IICs were items 3 ("If someone pushes me too far, I am likely to become violent."), 16 ("I do not laugh or cry at the same things other people do."), 25 ("Unexpected noises make me jump."), and 31 ("I lose my cool and explode over minor everyday things."). The four items that were rated as covert with the greatest consensus (77% to 85% agreement) and resulted in the most peaked IICs were items 12 ("I wonder why I am still alive when others have died."), 23 ("I am frightened by my urges."), 26 ("No one understands how I feel, not even my family."), and 28 ("I feel there are certain things that I have done that I can never tell anyone, because no one would ever understand.").

Once the four consensus overt items and the four consensus covert items had been determined, the ICCs and IICs for each of these items for both the veteran and spouse samples were plotted. Item functioning was assessed for the overt and covert items in both the veteran and spouse samples. Next, IICs for each item were compared by plotting the veteran's and spouse's curves on the same latent construct. Finally, a test information curve (TIC) was computed for the four consensus overt and four consensus covert items such that the information provided by each item was combined across items. Again, the additive TICs were compared across the veteran and spouse samples. In order to further elucidate differences among items between respondents, AUC analyses were conducted on the full scale and a unique pattern displayed by the spouses' responses was examined in further detail.

3. RESULTS

3.1 Overall Item Functioning

3.1.1 Veteran sample

Figure 1 displays the ICCs for all 34 items within the veteran sample. Table 4 contains the specific parameter values as well as the wording for each item. Each ICC represents the probability that an item will be endorsed at each level of the underlying PTSD dimension. Indeed, items do not behave the same across the latent dimension. As demonstrated in Figure 1, a veteran with PTSD falling at 1 *SD* above the mean of the underlying PTSD construct would be more likely to endorse item 25 (roughly a 94% chance) than item 32 (roughly a 34% chance). Examining the TIC for the full-scale measure, Figure 2 shows that the measure best distinguishes PTSD symptomatology at approximately 0.66 *SD*s above the mean level of the underlying PTSD construct.

3.1.2 Spouse sample

Female spouses also endorsed items with different probabilities across the latent construct of the veterans' PTSD. In Figure 3 and Table 5, women whose veteran spouses were at 1 *SD* above the mean for the underlying PTSD construct were more likely to endorse item 2 (roughly a 70% chance) than item 14 (roughly a 6% chance). Figure 4, the spouses' TIC for the full-scale measure, shows that the measure best distinguishes PTSD symptomatology at approximately 0.80 *SD*s, a level slightly higher than that of the veterans. In other words, PTSD symptomatology has to be at a greater severity overall before spouses are likely to endorse its presence.

3.2 Overt/Covert Item Functioning

3.2.1 Veteran sample

Examining separately those items identified as most clearly reflecting overt versus covert symptoms, Figure 5 indicates that, with regard to overt items, a veteran with PTSD falling at 1 *SD* above the mean of the latent construct would be more likely to endorse item 25 (roughly a 94% chance) than item 31 (roughly a 64% chance). A similar (albeit more moderate) pattern holds true for veterans' covert symptoms. Indeed, Figure 6 demonstrates that veterans at 1 *SD* of PTSD were more likely to endorse item 26 (roughly an 83% chance) than item 23 (roughly a 70 % chance). However, with the exception of a few items at the extremes, veterans had similar endorsement rates for items regardless of whether the item tapped overt versus covert symptoms. This is consistent with the current study's hypothesized outcome.

3.2.2 Spouse sample

Female spouses also endorsed items with different probabilities across the latent construct of the veterans' PTSD. As shown in Figure 7, women whose veteran spouses were at 1 *SD* for PTSD were more likely to endorse item 25 (roughly a 72% chance) than item 16 (roughly a 47% chance). Figure 8 displays the ICCs for the covert items within the spouse sample. Based on these results, spouses were more likely to endorse item 26 (roughly a 74% chance) than item 12 (roughly a 46% chance) at 1 *SD* of the veterans' PTSD. Contrary to this study's hypothesis, as with the veterans' self-reports, spouses generally showed similar rates of endorsement regardless of whether the item

was overt versus covert. However, consistent with findings from the scale as a whole, spouses also tended to endorse symptoms at higher levels of the latent construct overall.

3.3 Comparing Curves Across Samples

In order to highlight the item-level differences across samples, the overt and covert IICs for both the veterans and their spouses were plotted on the same latent construct with a solid line representing the veterans and a dashed line representing the spouses. Figure 9 presents the IICs for the overt items and Figure 10 the IICs for the covert items. Overall, spouses endorsed the veterans' symptoms only when they reached a greater level of severity. Furthermore, the level of information provided by the veteran was typically higher than that provided by the spouse. In other words, an endorsement of any given item by the veteran was typically more meaningful, or more related to the underlying construct of posttraumatic stress, than the same endorsement provided by the spouse. This distinction between veteran and spouse endorsement on overt versus covert items overall is shown in Figure 11 and Figure 12 which compare the TICs for the overt and covert items, respectively. Note that the TICs for the overt items provide nearly identical amounts of information. However, the spouses' TIC is pushed slightly to the right compared to the veterans' TIC. The covert item TICs show a similar pattern with regard to difficulty (i.e., the spouses' curve is slightly shifted to the right relative to the veterans' curve), but the difference in information provided by the veteran versus the spouse was more pronounced. Indeed, the information curve peaks at approximately 4 for the spouses whereas it peaks at 5.39 for the veterans.

Indeed, of the eight consensus overt and covert items, only two showed a different pattern than the one described above. For both item 3 ("If someone pushes me too far, I am likely to become violent.") and item 25 ("Unexpected noises make me jump."), an endorsement by the spouse provided more information than an endorsement by the veteran. Presumably, this increase in information for spouses on these two items stems from the fact that both items were rated to be overt, or readily discernible by intimate others.

To further elucidate the difference in information provided by veterans versus their spouses, analyses were conducted on the full 34-item scale to calculate the area under the curve (AUC) for each of the veteran and spouse IICs. Table 6 presents a detailed account of the results. Given that higher values indicate greater information, these analyses further confirmed that veterans were generally able to provide more information regarding their functioning than their spouses, particularly when it came to their covert symptoms.

3.4 Curves Showing Greater Information for Spouses

Upon evaluating the AUC results for the overt and covert items alone, it was determined that items 3 and 25 provided more information when endorsed by the spouses versus the veterans. However, these items represented only a portion of the data provided by the Mississippi Scale when considered as a whole. Hence, additional AUC analyses were conducted to determine which of the full-scale items, regardless of *a priori* overt or covert ratings, provided more information when answered by the spouses than the veterans and whether there was a pattern to these items.

Figure 13 shows the IICs for seven items displaying greater information for the spouse versus the veteran. Specifically, item 13 (“Being in certain situations makes me feel as though I am back in the past.”), item 19 (“I have found it easy to keep a job.”), item 27 (“I am an easy-going, even-tempered person.”), item 30 (“I feel comfortable when I am in a crowd.”), item 38 (“I feel ‘super-alert’ or ‘on guard’ much of time.”), as well as item 3 and item 25 were found to provide more information when endorsed by the spouse versus the veteran.

4. DISCUSSION AND CONCLUSION

Findings from the present study indicated that, overall, veterans were better able to recognize and report on their own PTSD symptoms in terms of both sensitivity and precision than their spouses. These results are congruent with previous findings of moderate agreement between spousal and veteran reports of PTSD using the Mississippi Scale (Niles et al., 1993; Taft et al., 1999), but are novel in that the current findings highlight functioning at the item level. Through the use of IRT analyses, the degree of relationship of each item to the underlying construct of the veterans' PTSD symptoms as well as the probability of endorsement was determined across veterans' and their spouses' reports.

Such an overall trend of more accurate reporting of PTSD symptoms by veterans compared to their spouses would suggest that informant reports may not provide incremental information for diagnosing PTSD and, hence, may not be necessary for veterans similar to those included in this study sample (i.e., veterans several years removed from military service). Indeed, these findings contradict the assertion that a thorough assessment of PTSD symptoms is best achieved through multiple methods and multiple sources (Keane et al., 1987; Taft et al., 1999). However, it is necessary to consider individual differences in veterans' willingness to disclose PTSD symptoms on self-report measures. With active-duty military personnel and more recent veterans, such self-disclosure may be less likely due to concerns stemming from the stigma associated

with mental illness as well as perceived barriers to mental health care (Greene-Shortridge, Britt, & Castro, 2007).

Examining the hypothesis that spouses would be better able to detect external behaviors than internal experiences, there was no overall differential endorsement pattern for overt versus covert items as determined *a priori* by an expert panel. Indeed, although it was determined that spouses' responses to items 3, 13, 19, 25, 27, 30, and 38 were more informative than veterans' responses, these items were not reliably rated as being overt. However, this pattern is congruent with prior research examining the differential impact of PTSD symptom clusters on family members. Except for item 13 which tapped reexperiencing symptoms, the majority of these items assessed for avoidance/numbing and hyperarousal symptoms. Such items likely provided more accuracy for the spouses than the veterans due to the fact that avoidance/numbing and hyperarousal symptoms are highly related to family adjustment problems and interpersonal distress (Cook, Riggs, Thompson, Coyne, & Sheikh, 2004; Evans, McHugh, Hopwood, & Watt, 2003; Hendrix, Erdmann, & Briggs, 1998; Nelson Goff, Crow, Reisbig, & Hamilton, 2009; Riggs, Byrne, Weathers, & Litz, 1998; Solomon, Dekel, & Zerach, 2008;Taft, Schumm, Panuzio, & Proctor, 2008). Thus, the negative impact of these symptoms on an intimate relationship likely made them more salient and amenable to detection by the spouse.

Further research using an IRT approach is necessary to determine whether findings from the current study generalize to active-duty military personnel or more recent veterans. Active-duty military personnel, in particular, may be motivated to deny

or underreport PTSD symptoms due to concerns with job placement, rank promotion, and mission assignment (Hoge et al., 2004). Conversely, veterans may be motivated to overreport symptoms of PTSD in order to gain service-connected disability compensation (Frueh et al., 2005). The study of specific military subpopulations (i.e., long-term veterans, recent veterans, and active-duty military personnel) would allow researchers to determine those items most amenable to detection by service members and their partners in each group and prove invaluable to the development of measures of PTSD symptoms or other emotional/behavioral disorders best suited to each of these populations.

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APPENDIX A

Figure 1
Item Characteristic Curves for Veteran Sample

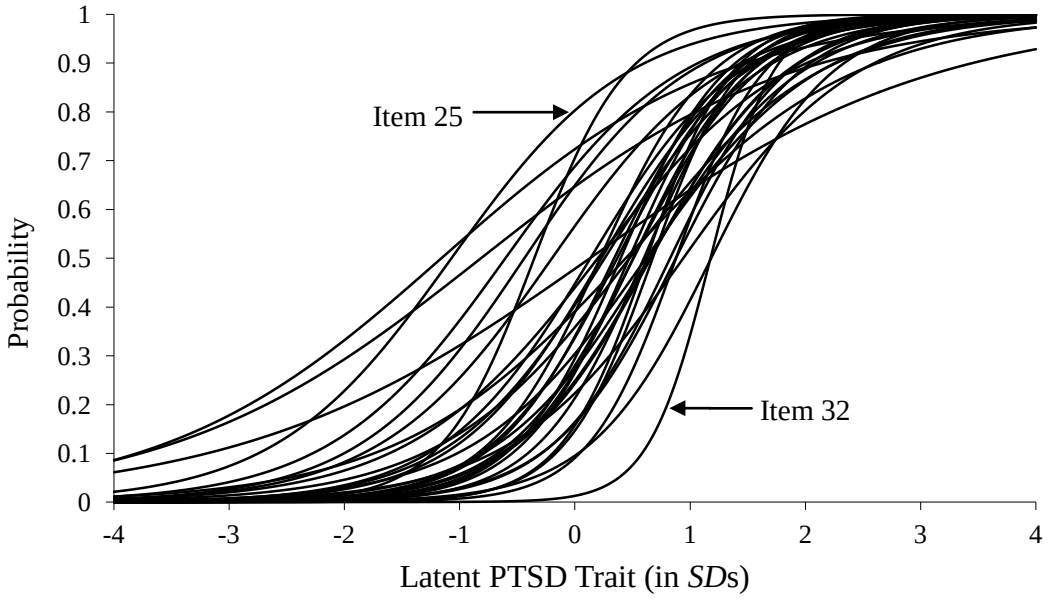


Figure 2
Test Information Curve for Veteran Sample

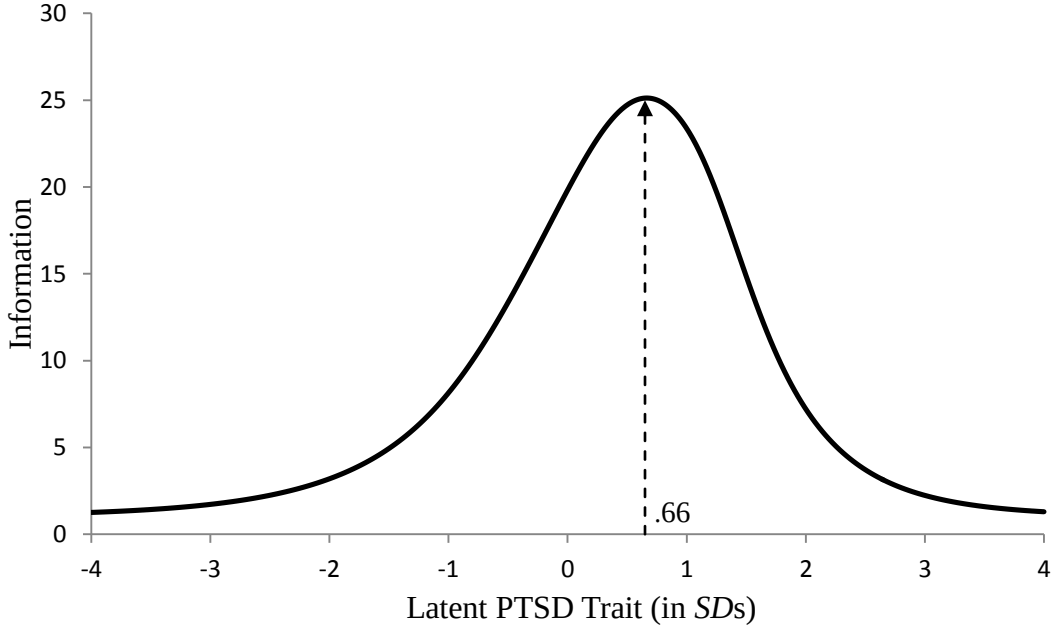


Figure 3
Item Characteristic Curves for Spouse Sample

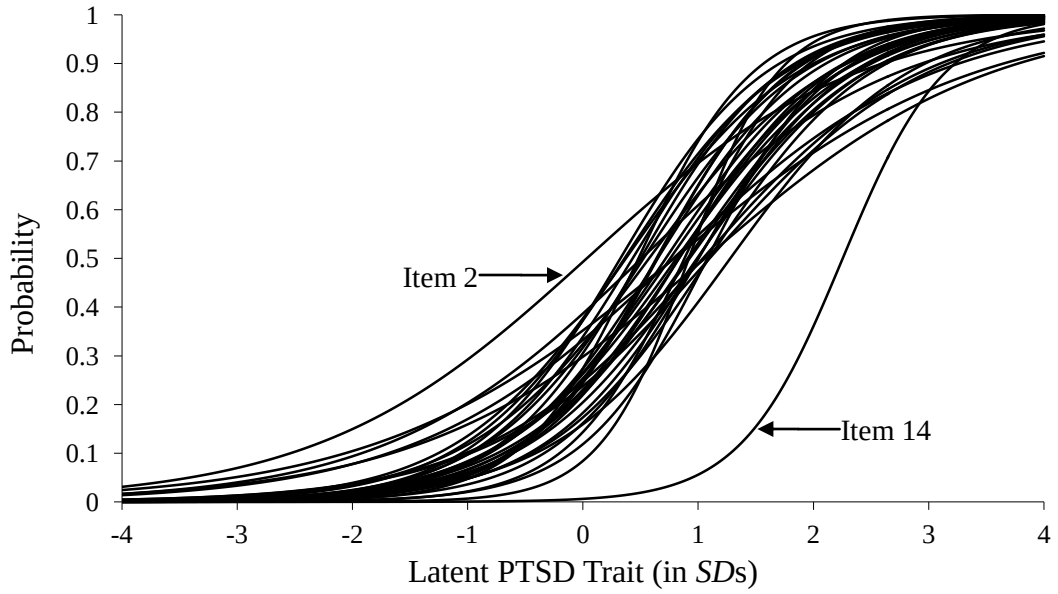


Figure 4
Test Information Curve for Spouse Sample

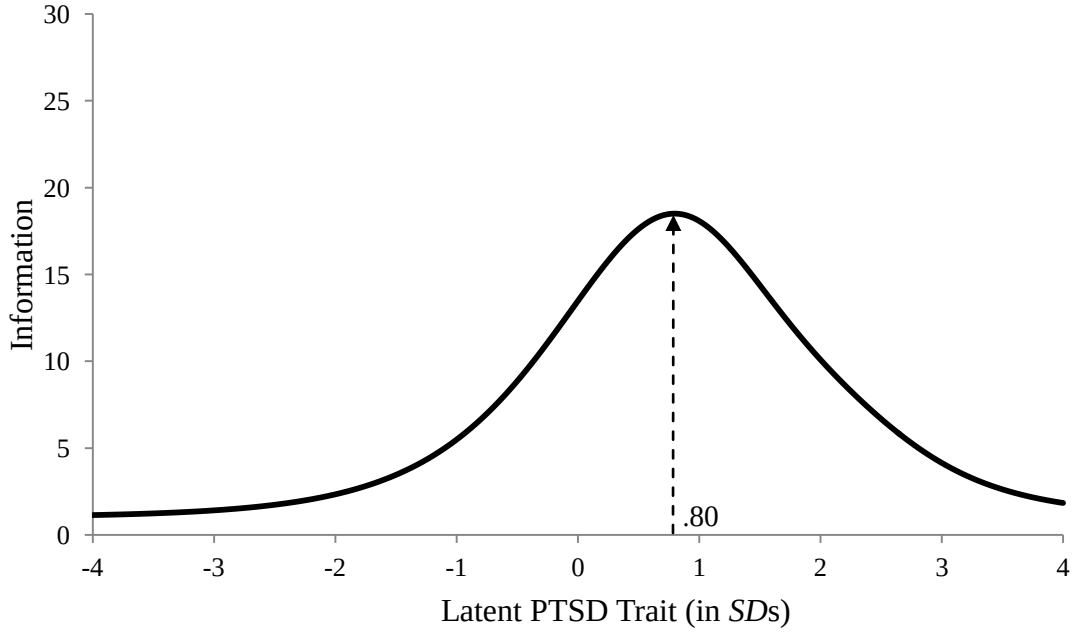


Figure 5

Item Characteristic Curves for Four Consensus Overt Items – Veteran Sample

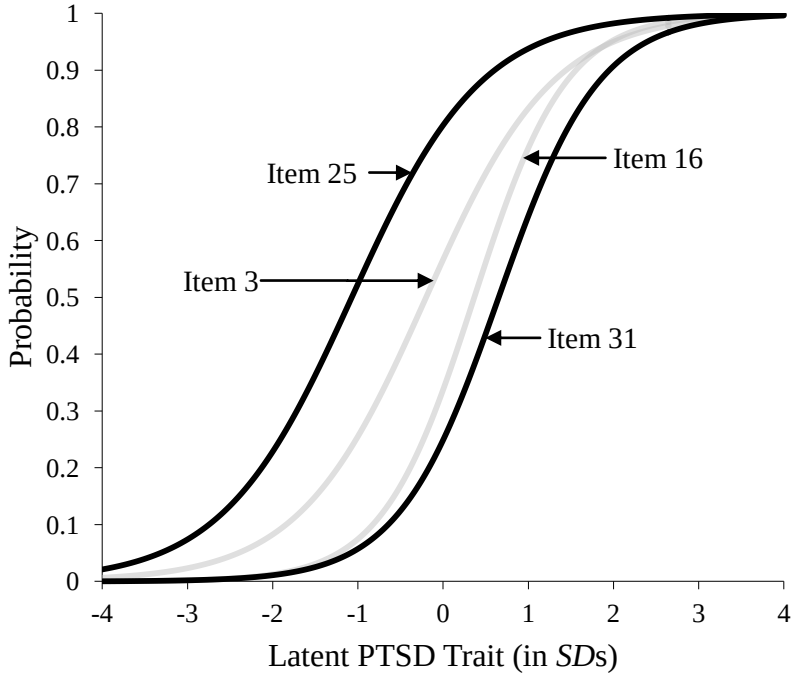


Figure 6

Item Characteristic Curves for Four Consensus Covert Items – Veteran Sample

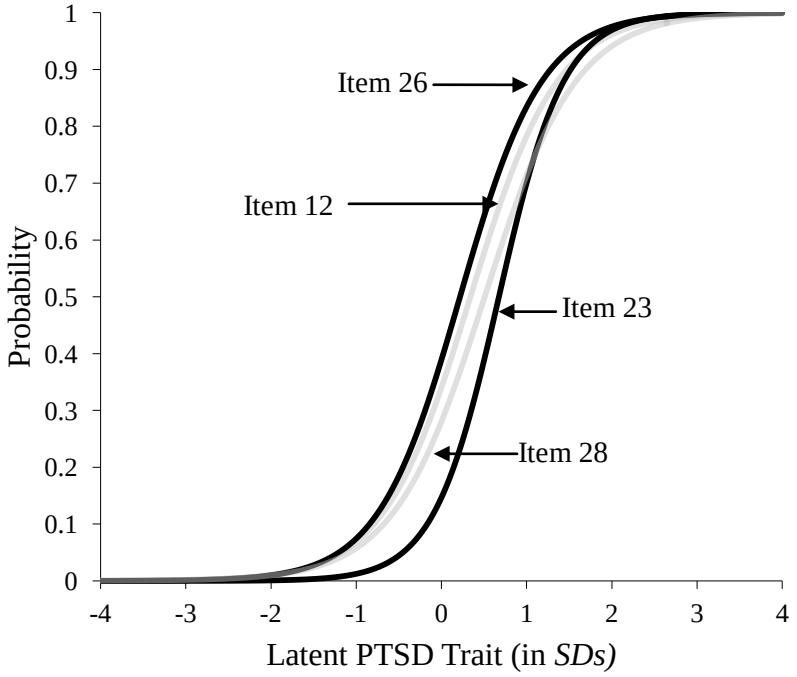


Figure 7
Item Characteristic Curves for Four Consensus Overt Items – Spouse Sample

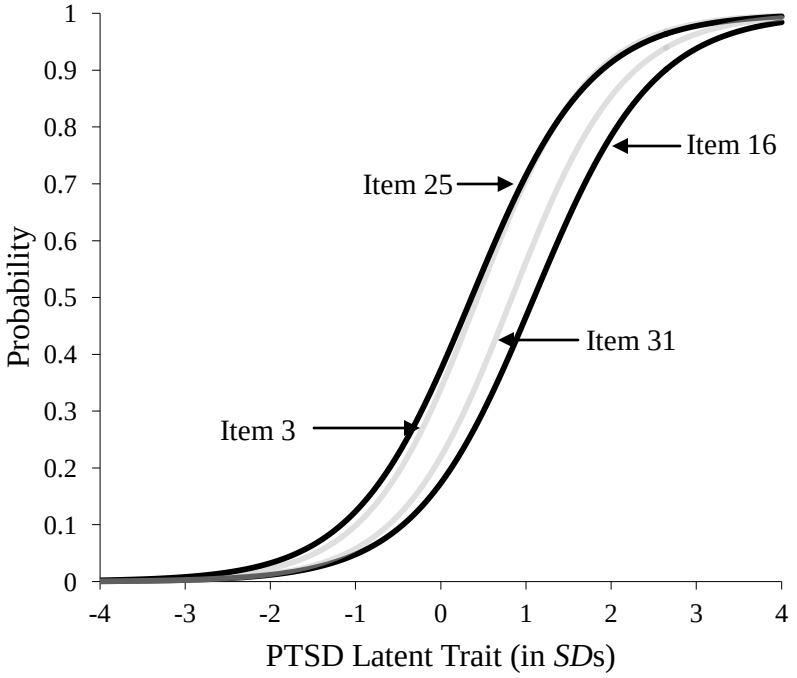


Figure 8
Item Characteristic Curves for Four Consensus Covert Items – Spouse Sample

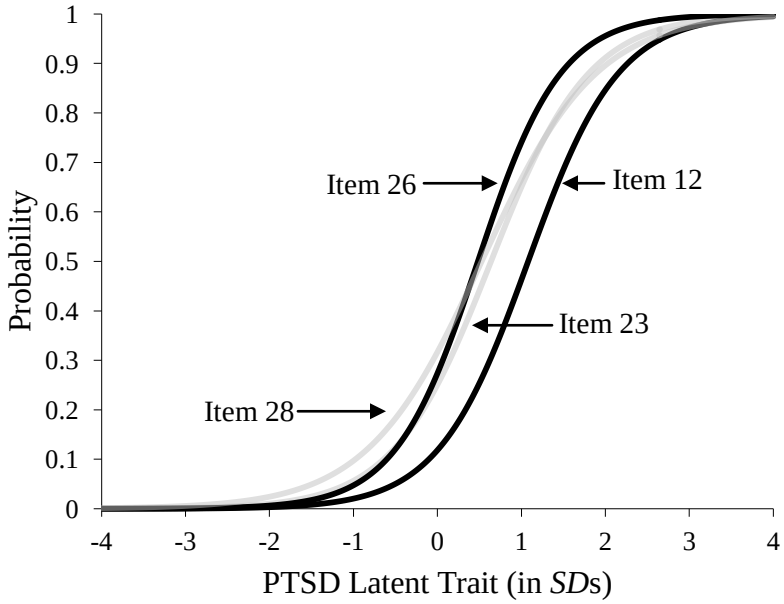


Figure 9

Combined Item Information Curves for Four Consensus Overt Items

Figure 10

Combined Item Information Curves for Four Consensus Covert Items

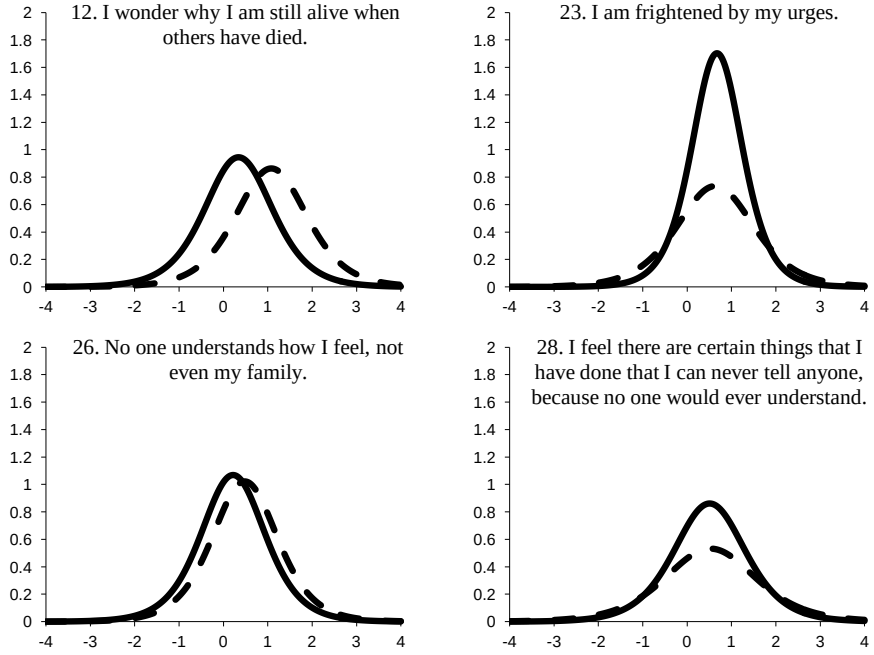


Figure 11

Combined Test Information Curves for Four Consensus Overt Items

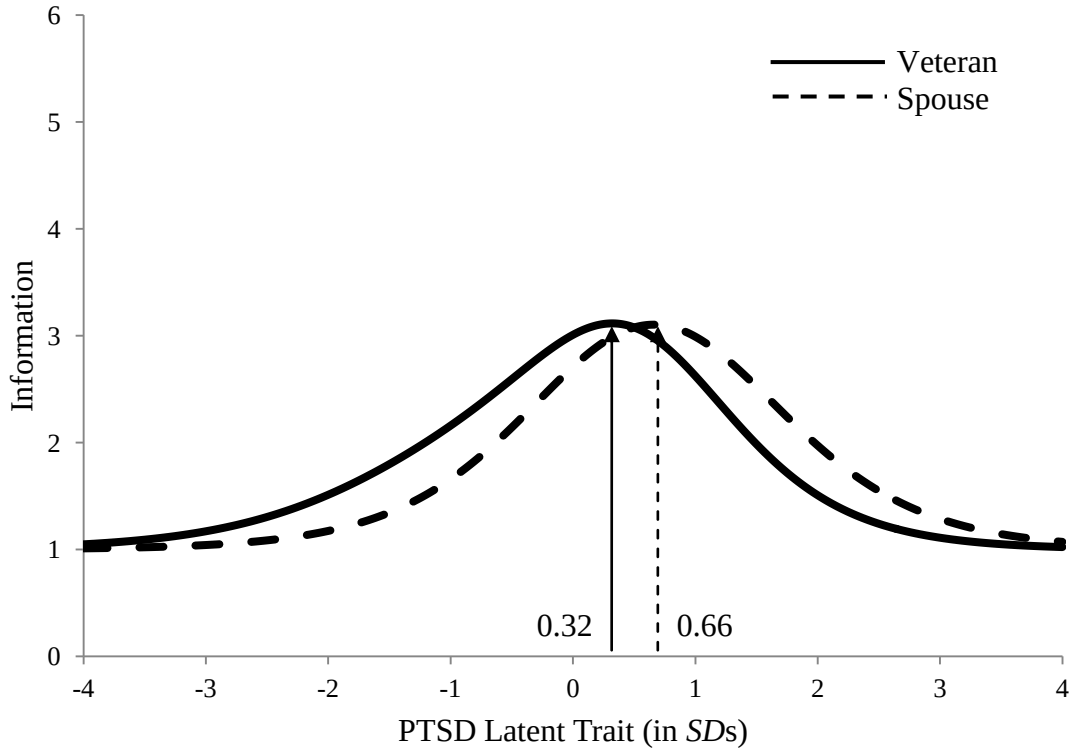


Figure 12

Combined Test Information Curves Four Consensus Covert Items

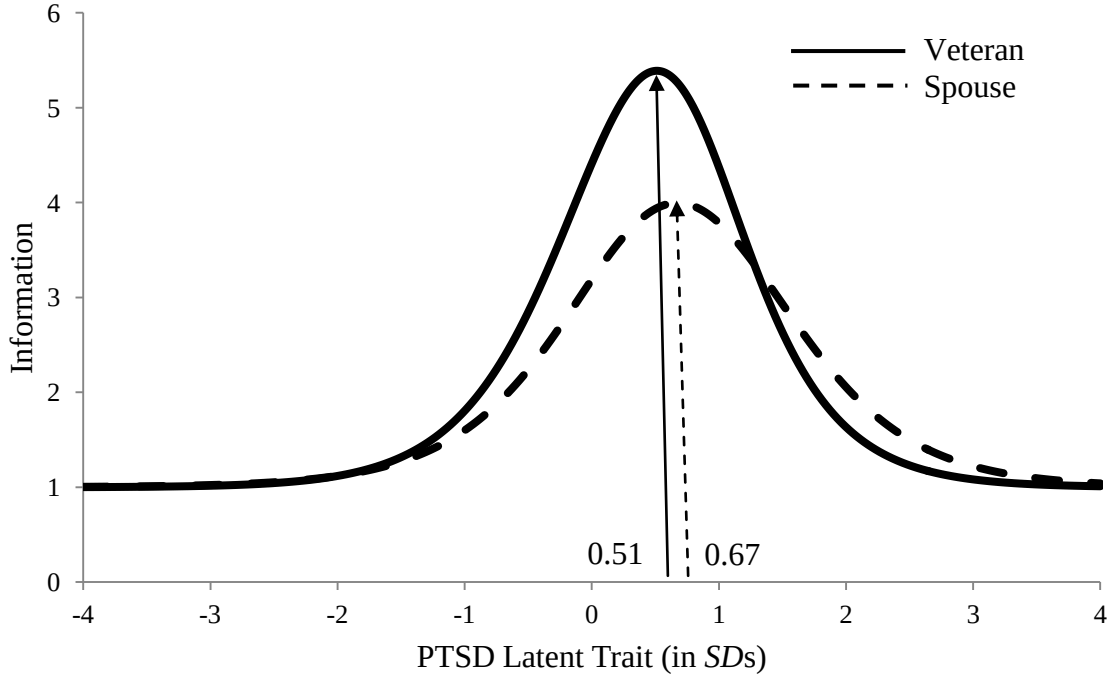
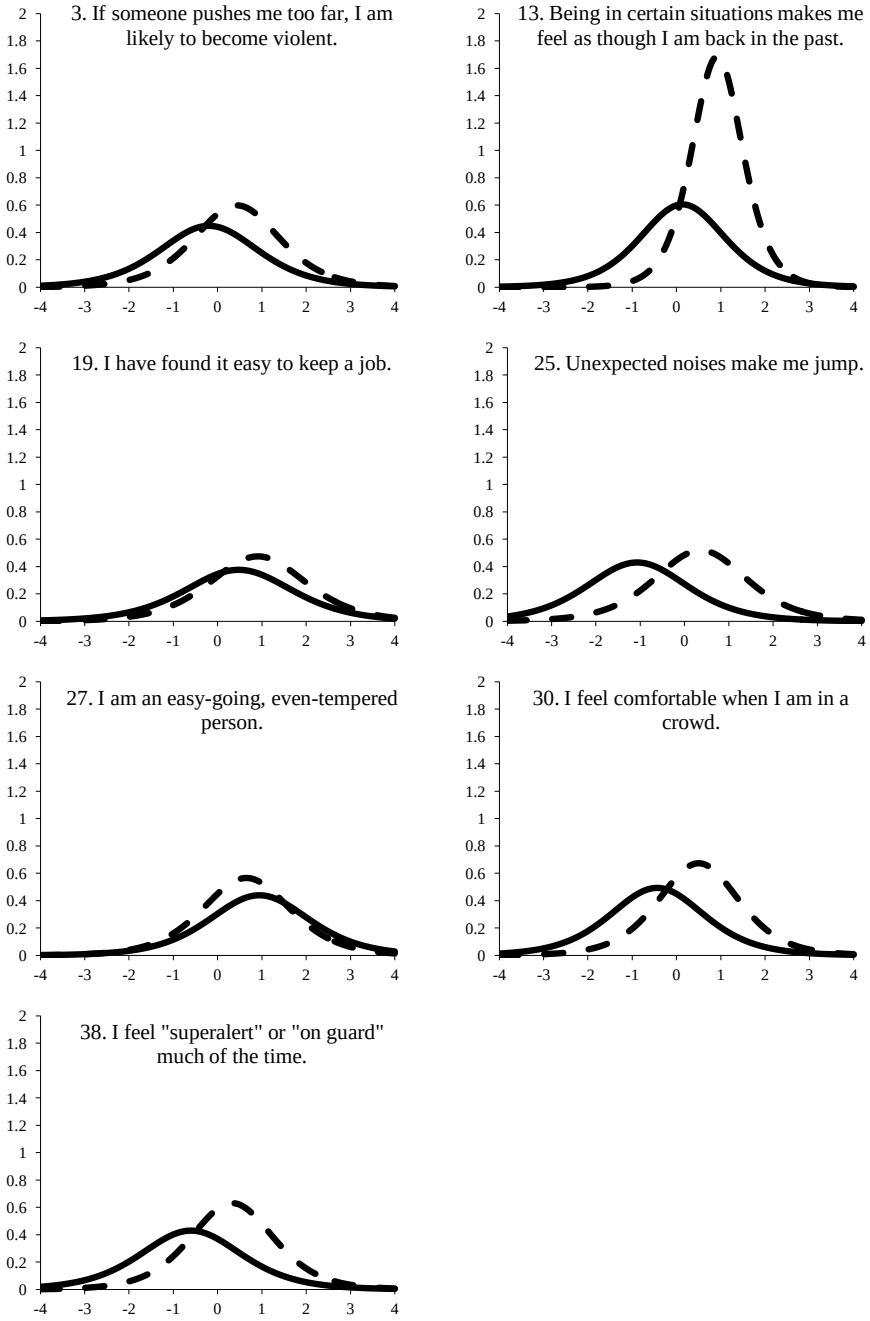


Figure 13
Item Information Curves for Most Informative Spouse Items



APPENDIX B

Table 1
Fit Indices for Unidimensionality: Testing Iterations

	CFI	TLI	RMSEA
39-Item Scale			
Veteran*	0.96	0.98	0.05
Spouse	0.95	0.98	0.04
36-Item Scale			
Veteran	0.96	0.98	0.05
Spouse*	0.96	0.98	0.04
35-Item Scale			
Veteran	0.95	0.98	0.05
Spouse*	0.96	0.98	0.04
34-Item Scale			
Veteran	0.95	0.98	0.05
Spouse	0.96	0.98	0.04

Note. * = Dataset produced an error message in MPlus.

Table 2
Demographics of Expert Sample

Variable	Rating sample (n = 35)
Decade of Birth, *n* (%)	
1940s	1 (2.9)
1950s	2 (5.7)
1960s	3 (8.6)
1970s	12 (34.3)
1980s	17 (48.6)
Gender	
Male	11 (31.4)
Female	23 (65.7)
Profession	
Psychologist	22 (62.9)
Social worker	2 (5.7)
Psychology intern/resident	7 (20.0)
Nurse	1 (2.9)
Graduate student	3 (8.6)
Work setting	
Outpatient primary care clinic	12 (34.3)
Outpatient psychiatric/mental health clinic	17 (48.6)
Outpatient PTSD program	4 (11.4)
Other residential program	1 (2.9)
Other	1 (2.9)

Table 3
Overt/Covert Ratings

Item #	Content	Majority rating (> 50%)
Overt		
3	If someone pushes me too far, I am likely to become violent.	62
11	I fall asleep, stay asleep and awaken only when the alarm goes off.	77
14	My dreams at night are so real that I waken in a cold sweat and force myself to stay awake.	58
16	I do not laugh or cry at the same things other people do.	69
19	I have found it easy to keep a job.	54
24	I fall asleep easily at night.	58
25	Unexpected noises make me jump.	77
27	I am an easy-going, even-tempered person.	54
31	I lose my cool and explode over minor everyday things.	77
Covert		
2	I do not feel guilt over things that I did in the past.	69
8	When I think of some of the things that I did in the military, I wish I were dead.	89
10	Lately, I have felt like killing myself.	85
12	I wonder why I am still alive when others have died.	85
15	I feel like I cannot go on.	89
23	I am frightened by my urges.	85
26	No one understands how I feel, not even my family.	77
28	I feel there are certain things that I have done that I can never tell anyone, because no one would ever understand.	85

Table 4
Veteran Responses: Item Content and Item Parameters

Item #	Content	*a*	*b*
1	In the past, I had more close friends than I have now.	1.21	0.20
2	I do not feel guilt over things that I did in the past.	0.66	0.13
3	If someone pushes me too far, I am likely to become violent.	1.34	-0.20
4	If something happens that reminds me of the past, I become very distressed and upset.	2.16	0.47
5	The people who know me best are afraid of me.	1.91	1.18
6	I am able to get emotionally close to others.	0.74	-0.82
7	I have nightmares of experiences in my past that really happened.	1.98	0.51
9	It seems as if I have no feelings.	2.20	0.40
11	I fall asleep, stay asleep and awaken only when the alarm goes off	0.83	-1.16
12	I wonder why I am still alive when others have died.	1.94	0.34
13	Being in certain situations makes me feel as though I am back in the past.	1.56	0.13
14	My dreams at night are so real that I waken in a cold sweat and force myself to stay awake.	2.63	0.88
16	I do not laugh or cry at the same things other people do.	1.84	0.37
17	I still enjoy doing many of the things that I used to enjoy.	1.72	0.66
18	Daydreams are very real and frightening.	1.97	0.83
19	I have found it easy to keep a job.	1.23	0.47
20	I have trouble concentrating on tasks.	1.52	0.64
21	I have cried for no good reason.	1.88	0.88
22	I enjoy the company of others.	1.51	0.26
23	I am frightened by my urges.	2.61	0.67
24	I fall asleep easily at night.	1.61	0.23
25	Unexpected noises make me jump.	1.31	-1.07
26	No one understands how I feel, not even my family.	2.07	0.22
27	I am an easy-going, even-tempered person.	1.33	0.94
28	I feel there are certain things that I have done that I can never tell anyone, because no one would ever understand.	1.86	0.51
30	I feel comfortable when I am in a crowd.	1.40	-0.44
31	I lose my cool and explode over minor everyday things.	1.69	0.65
32	I am afraid to go to sleep at night.	3.70	1.18
33	I try to stay away from anything that will remind me of things which happened in the past.	2.18	0.60

Note. *a* = discrimination; *b* = difficulty.

Table 4 Continued

Item #	Content	*a*	*b*
34	My memory is as good as it ever was.	1.01	0.44
35	I have a hard time expressing my feelings, even to the people I care about.	2.48	-0.35
36	At times I suddenly act or feel as though something that happened in the past were happening all over again.	2.69	0.62
37	I am not able to remember some important things that happened in the past.	1.34	0.62
38	I feel "superalert" or "on guard" much of the time.	1.31	-0.60

Table 5
Spouse Responses: Item Content and Item Parameters

Item #	Content	*a*	*b*
1	In the past, I had more close friends than I have now.	0.90	0.51
2	I do not feel guilt over things that I did in the past.	0.86	0.03
3	If someone pushes me too far, I am likely to become violent.	1.55	0.43
4	If something happens that reminds me of the past, I become very distressed and upset.	1.33	0.81
5	The people who know me best are afraid of me.	0.81	1.06
6	I am able to get emotionally close to others.	0.89	0.78
7	I have nightmares of experiences in my past that really happened.	1.64	1.00
9	It seems as if I have no feelings.	1.06	1.10
11	I fall asleep, stay asleep and awaken only when the alarm goes off	0.77	0.79
12	I wonder why I am still alive when others have died.	1.86	1.08
13	Being in certain situations makes me feel as though I am back in the past.	2.60	0.92
14	My dreams at night are so real that I waken in a cold sweat and force myself to stay awake.	2.25	1.00
16	I do not laugh or cry at the same things other people do.	1.43	1.09
17	I still enjoy doing many of the things that I used to enjoy.	1.32	0.92
18	Daydreams are very real and frightening.	1.30	1.28
19	I have found it easy to keep a job.	1.38	0.91
20	I have trouble concentrating on tasks.	1.50	1.00
21	I have cried for no good reason.	1.37	0.99
22	I enjoy the company of others.	1.42	0.72
23	I am frightened by my urges.	1.71	0.64
24	I fall asleep easily at night.	1.35	0.37
25	Unexpected noises make me jump.	1.44	0.36
26	No one understands how I feel, not even my family.	2.02	0.48
27	I am an easy-going, even-tempered person.	1.51	0.65
28	I feel there are certain things that I have done that I can never tell anyone, because no one would ever understand.	1.46	0.53
30	I feel comfortable when I am in a crowd.	1.64	0.50
31	I lose my cool and explode over minor everyday things.	1.52	0.83
32	I am afraid to go to sleep at night.	2.03	0.88
33	I try to stay away from anything that will remind me of things which happened in the past.	1.74	0.65

Note. *a* = discrimination; *b* = difficulty.

Table 5 Continued

Item #	Content	*a*	*b*
34	My memory is as good as it ever was.	1.07	1.04
35	I have a hard time expressing my feelings, even to the people I care about.	1.28	0.57
36	At times I suddenly act or feel as though something that happened in the past were happening all over again.	1.45	0.83
37	I am not able to remember some important things that happened in the past.	1.36	0.76
38	I feel "superalert" or "on guard" much of the time.	1.59	0.32

Table 6

Area Under the Curve Values for Veterans and Spouses

Item #	Content	Veteran AUC	Spouse AUC
1	In the past, I had more close friends than I have now.	1.19	0.85
2	I do not feel guilt over things that I did in the past.	0.57	0.80
3	If someone pushes me too far, I am likely to become violent.	1.33	1.54
4	If something happens that reminds me of the past, I become very distressed and upset.	2.16	1.31
5	The people who know me best are afraid of me.	1.90	0.73
6	I am able to get emotionally close to others.	0.66	0.83
7	I have nightmares of experiences in my past that really happened.	1.97	1.63
9	It seems as if I have no feelings.	2.20	1.01
11	I fall asleep, stay asleep and awaken only when the alarm goes off	0.75	0.69
12	I wonder why I am still alive when others have died.	1.94	1.85
13	Being in certain situations makes me feel as though I am back in the past.	1.55	2.60
14	My dreams at night are so real that I waken in a cold sweat and force myself to stay awake.	2.63	2.21
16	I do not laugh or cry at the same things other people do.	1.84	1.40
17	I still enjoy doing many of the things that I used to enjoy.	1.72	1.29
18	Daydreams are very real and frightening.	1.97	1.26
19	I have found it easy to keep a job.	1.21	1.36
20	I have trouble concentrating on tasks.	1.51	1.48
21	I have cried for no good reason.	1.87	1.35
22	I enjoy the company of others.	1.50	1.40
23	I am frightened by my urges.	2.61	1.71
24	I fall asleep easily at night.	1.61	1.34
25	Unexpected noises make me jump.	1.28	1.43
26	No one understands how I feel, not even my family.	2.07	2.02
27	I am an easy-going, even-tempered person.	1.30	1.49
28	I feel there are certain things that I have done that I can never tell anyone, because no one would ever understand.	1.85	1.45
30	I feel comfortable when I am in a crowd.	1.39	1.64
31	I lose my cool and explode over minor everyday things.	1.69	1.51
32	I am afraid to go to sleep at night.	3.70	2.02

Table 6 Continued

Item #	Content	Veteran AUC	Spouse AUC
33	I try to stay away from anything that will remind me of things which happened in the past.	2.18	1.74
34	My memory is as good as it ever was.	0.97	1.02
35	I have a hard time expressing my feelings, even to the people I care about.	2.48	1.26
36	At times I suddenly act or feel as though something that happened in the past were happening all over again.	2.69	1.43
37	I am not able to remember some important things that happened in the past.	1.32	1.34
38	I feel "superalert" or "on guard" much of the time.	1.29	1.58